BELL WORK, 6-Mar-2017

Write a balanced equation for the reaction below:

Zinc and bromide react to for Zinc (II) Bromide

In series of trials a student recorded the following data when reacting Zinc and Bromide

	Trial A	**Trial B**
Mass of Zinc (M.M. 65g/mol)	5.00g	10.0g
Moles of Zinc		
Mass of Bromine (M.M. 160g/mol)	15.0g	18.0g
Moles of Bromine		
Mole ratio of zinc to Bromine		
What is the Limiting reagent		

Agenda

Pressure units and Kelvin

Objective

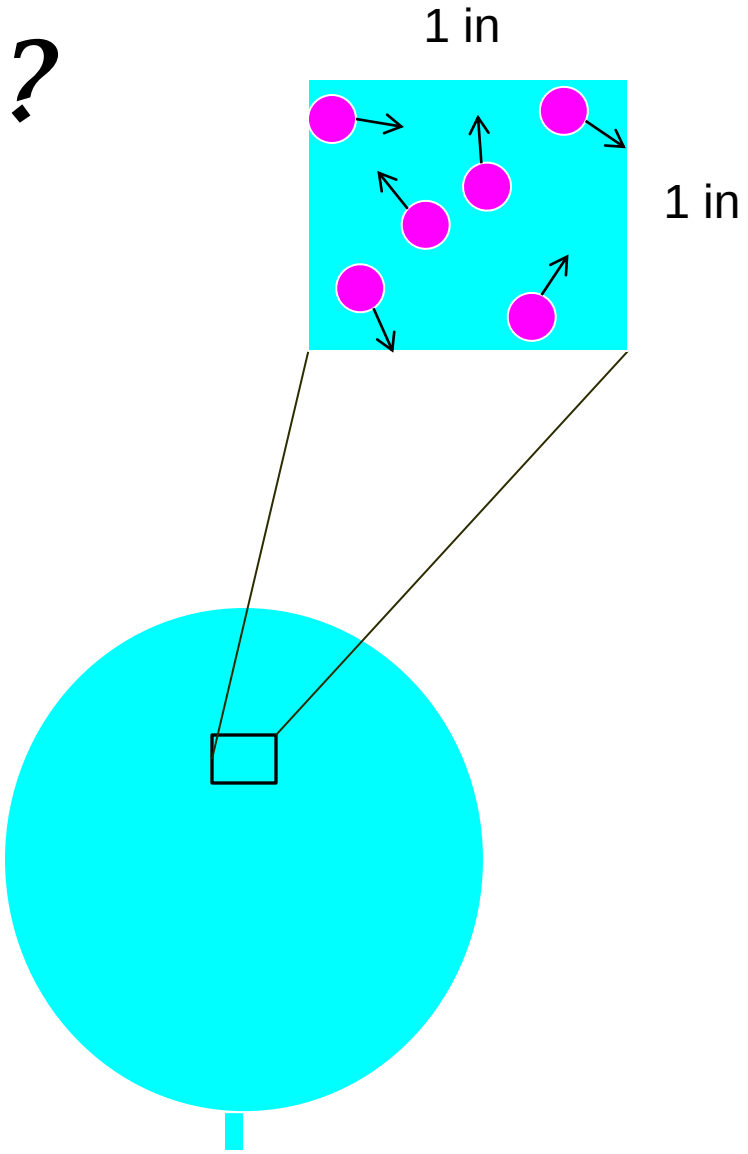
You will be able to convert between different pressure units.

What is pressure?

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Units of Pressure

1 pascal (Pa) = 1 N/m²



1atm =

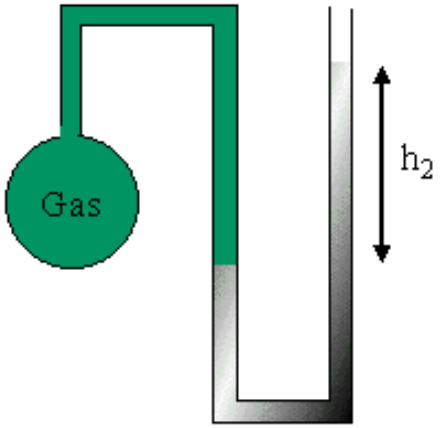
760 mmHg =

760 torr =

101.325 kPa =

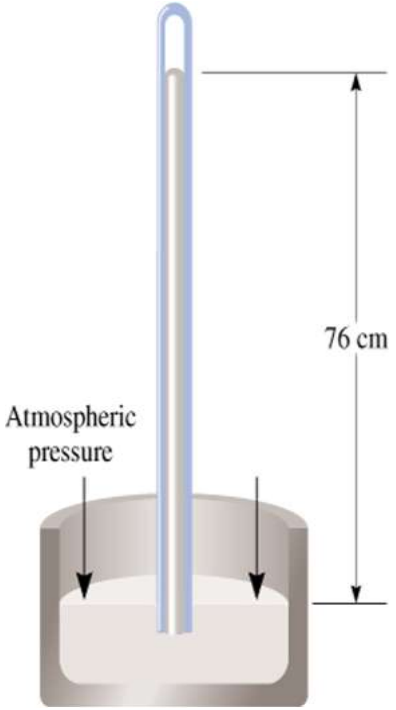
14.7psi

How do we measure pressure?



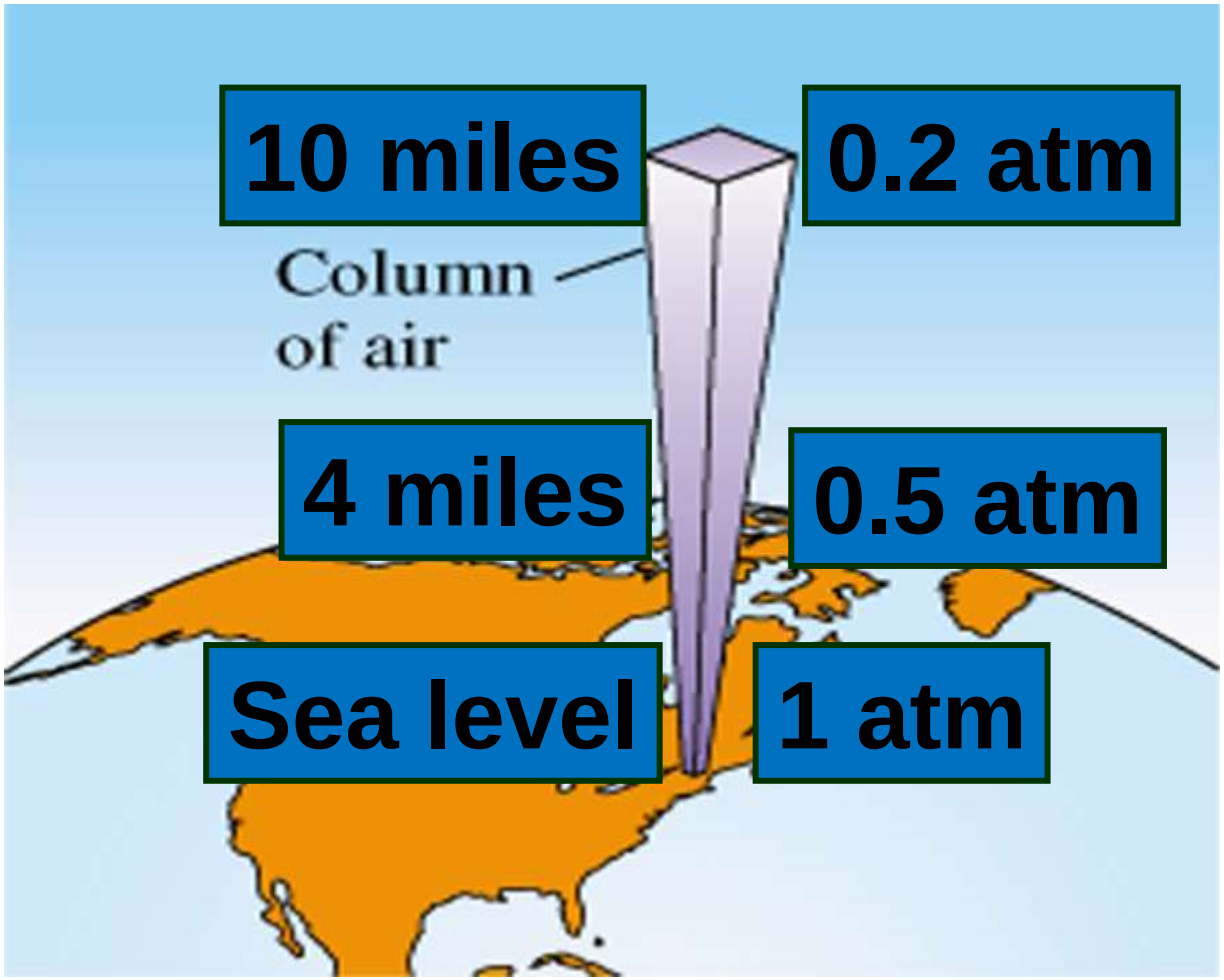
A <u>manometer</u> uses a U-shaped tube of liquid to measure pressure differences on either side of the liquid

A <u>barometer</u> uses the height of a column of mercury to measure gas pressure in mmHg



https://www.youtube.com/watch?v=EkDhlzA-lwI

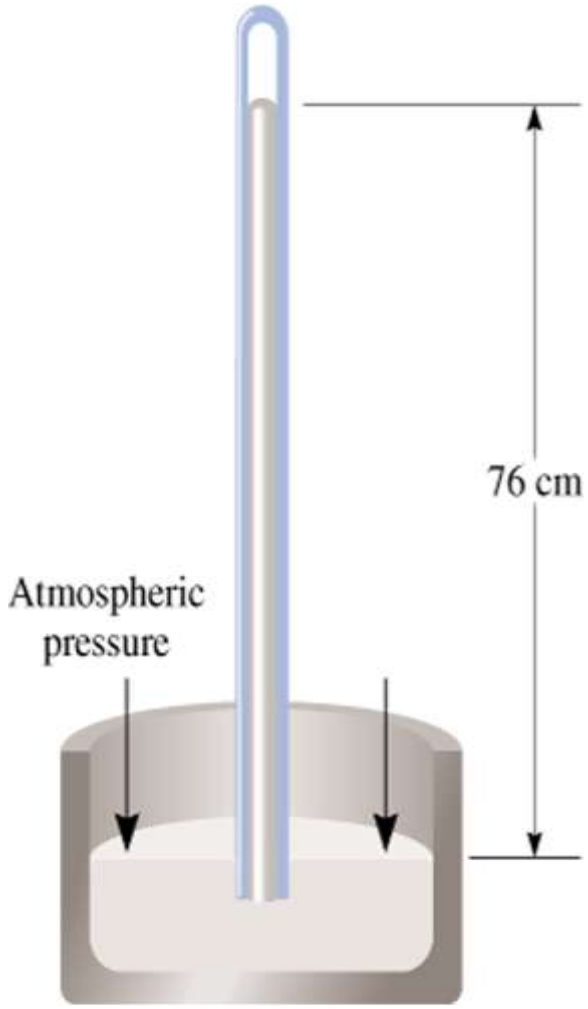
What is the pressure in mmHg at sea level?
What is the pressure in Pascals at sea level?



Try this…

Convert:

1. **727 mmHg into kPa**
2. **52.5 kPa into atm**
3. **0.729 atm into mmHg**
4. **522 torr into kPa**
5. **800.0 mmHg into atm**
6. **495Pa into mmHg**



Barometer

Standard Temperature and Pressure

Standard temperature and pressure (**STP)** refers to nominal conditions in the atmosphere at sea level. This value is important to physicists, chemists, engineers, pilots and navigators. Why?

Temperature = 0° C or 273K
Pressure = 1atm

All temperature must be converted to Kelvin

To convert ^{0}C → K

$$T\,(\mathrm{K}) = t\,(^0\mathrm{C}) + 273$$

To convert K→ ^{0}C

$$T\,(^0\mathrm{C}) = t\,(\mathrm{K}) - 273$$

Why is the Kelvin scale used exclusively in gas law calculations?

BELL WORK 7-Mar-2017

Long onto a computer and sign into Mozilla or Chrome.

Go to class web page and open the lab section.

While you wait for computer to load complete the following:

Solve the following equation for V_2:

$$P_1V_1 = P_2V_2$$

What is the equivalent pressure for a tank of compressive gas at 2.8atm if you are asked to report value in mmHg?

Computer simulation

Agenda

Objective

To explore how gases are affected by different variables using a computer simulation

Computer simulation

- From class web page in lab sections open "**PhET Gas Laws Simulation**"
- Launch the simulation

  URL:

  http://phet.colorado.edu/en/simulation/gas-properties

-OR-

- Google: "gas law PhET simulation"

Before you answering questions…

That you can…

1. Add both heavy and light gases to the container

2. Adjust the temperature of the container while holding the pressure constant

3. Decrease the volume of the container

PhET Gas Simulation Turn In

Answer all question on separate sheet of paper labeled “PhET Gas Simulation”

Compose a properly formatted email to send graphs saved to a single sheet as a pdf. and forward to Mr. Golden by 8:30am 9.Mar.2017.

Save pdf. as follows, Name: Joe Schmo, Period 1 “JoeSchmoPhETgaslawsP1”

BELL WORK 8-Mar-2017

Draw three different balloons with air particles in them

1. **One full of gas at room temperature**

2. **One full of gas at 0 °C (~32 ° F)**

3. **One full of gas at 50 °C (~122 ° F)**

Using dots show particles inside each of the balloons

Use arrows to indicate how fast they are moving (longer arrow = faster)

Rank the balloons from lowest to highest pressure

BELL WORK 9-Mar-2017

Using the gas law formula for changing volume and temperature while holding moles and pressure constant solve for V_2.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

EQ: Where else in life do we make assumption to simplify a situation?

Agenda

Gas properties and the KMT

Objective(s)

To explain properties of gases using the kinetic molecular theory

To explain to a group of peer one of the tenitis of the KMT of gasses.

PhET Gas Law Simulation

Pass it forward, time to turn in

Demo

Write on your bellwork what you predict is going to happen

Write down what you actually observed

KMT

In your assigned pairing (post it note), you will spend 5min coming up with an explanation of how the component of KMT you are assigned applies to the computer simulation or either of the demos.

Explanation should be 2-4 sentence written out.

You will present this to other students

Boyles ($P_1V_1 = P_2V_2$) and Charles Law($V_1/T_1 = V_2/T_2$)

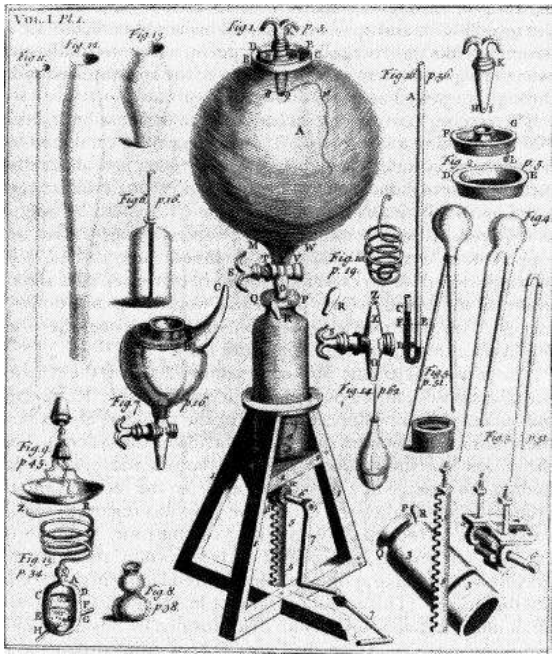
.If a gas at 25.0 °C occupies 3.60 liters at a pressure of 1.00 atm, what will be its volume at a pressure of 2.50 atm?

A gas sample at 40.0°C occupies a volume of 2.32 L. If the temperature is raised to 75.0°C, what will the volume be, assuming the pressure remains constant?

Closure

What are three (3) assumption made in the KMT of gasses regarding gas behavior and properties

Boyle's Law



Bell Work; 10.Mar.17

What is the relationship between pressure and volume if temperature and moles are held constant?

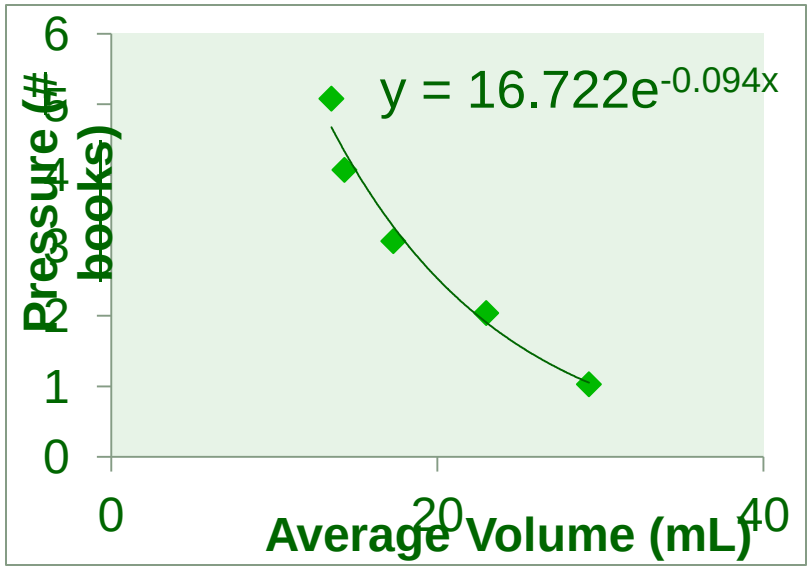
Boyles ($P_1V_1 = P_2V_2$) and Charles Law($V_1/T_1 = V_2/T_2$)

If a gas at 25.0 °C occupies 3.60 liters at a pressure of 1.00 atm, what will be its volume at a pressure of 2.50 atm?

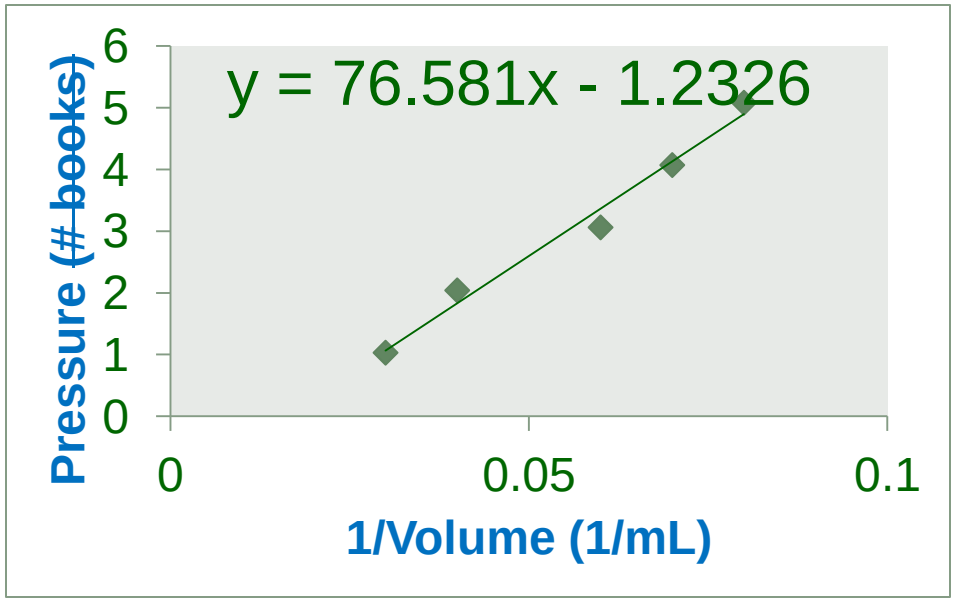
A gas sample at 40.0°C occupies a volume of 2.32 L. If the temperature is raised to 75.0°C, what will the volume be, assuming the pressure remains constant?

Boyle's Law, Data Analysis

Volume v. Pressure



1/Volume v.



When graphing V vs. P the slope is exponential (instantaneous/ not constant) so when we re-graph as V^{-1} vs. P we get a linear slope (constant)

Boyle's Law

In a system in which the amount of gas in a system stays the same and the temperature remains constant:

$$P_1V_1 = P_2V_2$$

P_1 and P_2 must be in the <u>same units</u>

V_1 and V_2 must be in the <u>same units</u>

Now Try This

At STP a sample of nitrogen takes up a volume of 50L. What is the new volume if the pressure is changed to 220 mmHg.

V_2 = ?

P_2 = 220mmHg x $\frac{1atm}{760mmHg}$ = 0.289atm

$P_1V_1 = P_2V_2$

$P_1V_1/P_2 = V_2$

V_1 = 50L

P_1 (STP) = 1atm

(1atm)(50L)/(0.289atm)= V_2

173L= V_2

Elements that exist as gases at 25˚C and 1 atmosphere

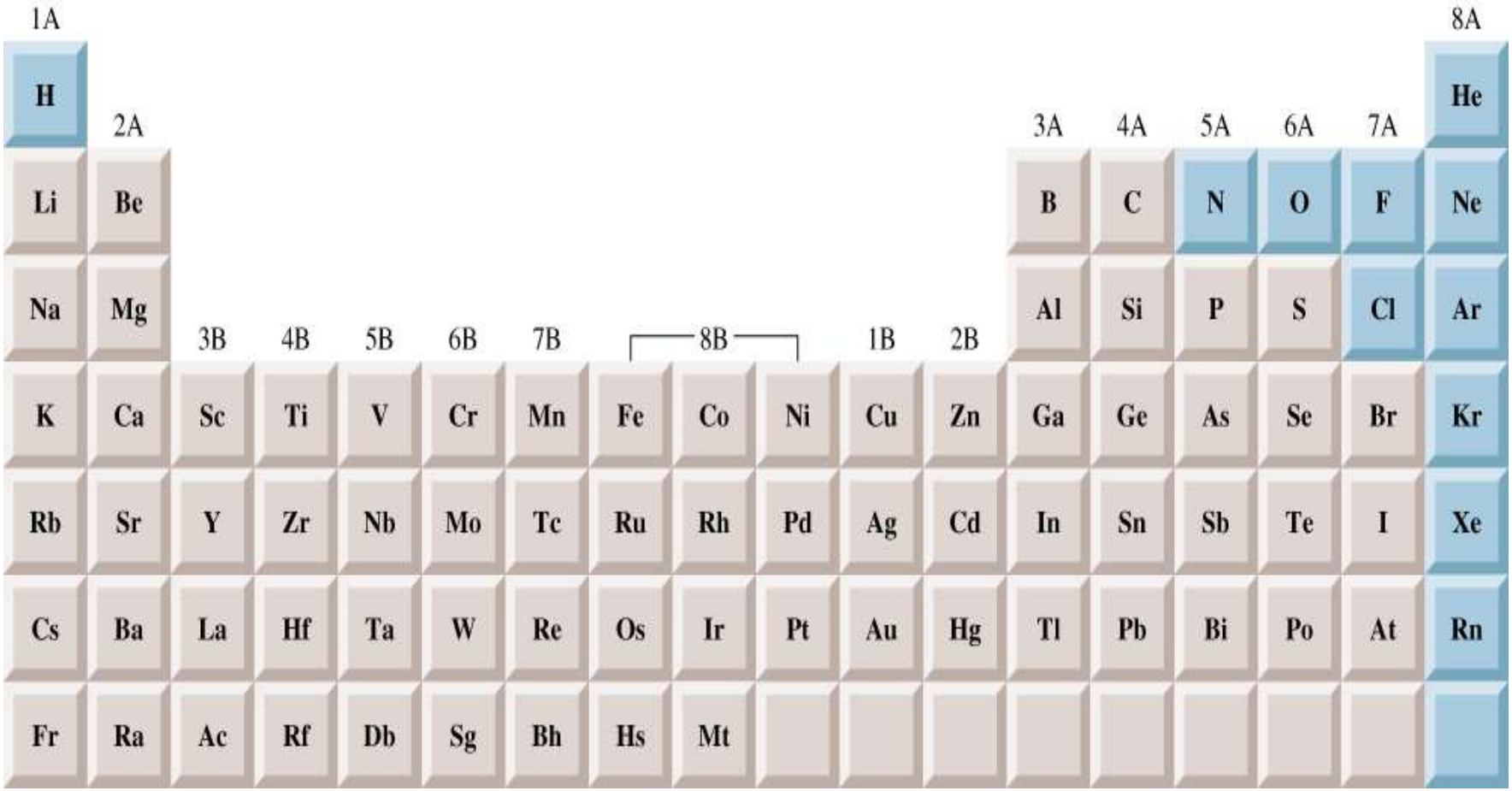


Table 5.1 Some Substances Found as Gases at 1 atm and 25°C

Elements	Compounds
H_2 (molecular hydrogen)	HF (hydrogen fluoride)
N_2 (molecular nitrogen)	HCl (hydrogen chloride)
O_2 (molecular oxygen)	HBr (hydrogen bromide)
O_3 (ozone)	HI (hydrogen iodide)
F_2 (molecular fluorine)	CO (carbon monoxide)
Cl_2 (molecular chlorine)	CO_2 (carbon dioxide)
He (helium)	NH_3 (ammonia)
Ne (neon)	NO (nitric oxide)
Ar (argon)	NO_2 (nitrogen dioxide)
Kr (krypton)	N_2O (nitrous oxide)
Xe (xenon)	SO_2 (sulfur dioxide)
Rn (radon)	H_2S (hydrogen sulfide)
	HCN (hydrogen cyanide)*

** The boiling point of HCN is 26°C, but it is close enough to qualify as a gas at ordinary atmospheric conditions.*

Try Again using "Box Method"

4.35 L of a gas is at 1.16 atm. What pressure is obtained when the volume is 9.3 L?

1. What you want?	
2. Given Information	4. Plan
	5. Calculations for solutions
3. Useful formulas/ conversions	

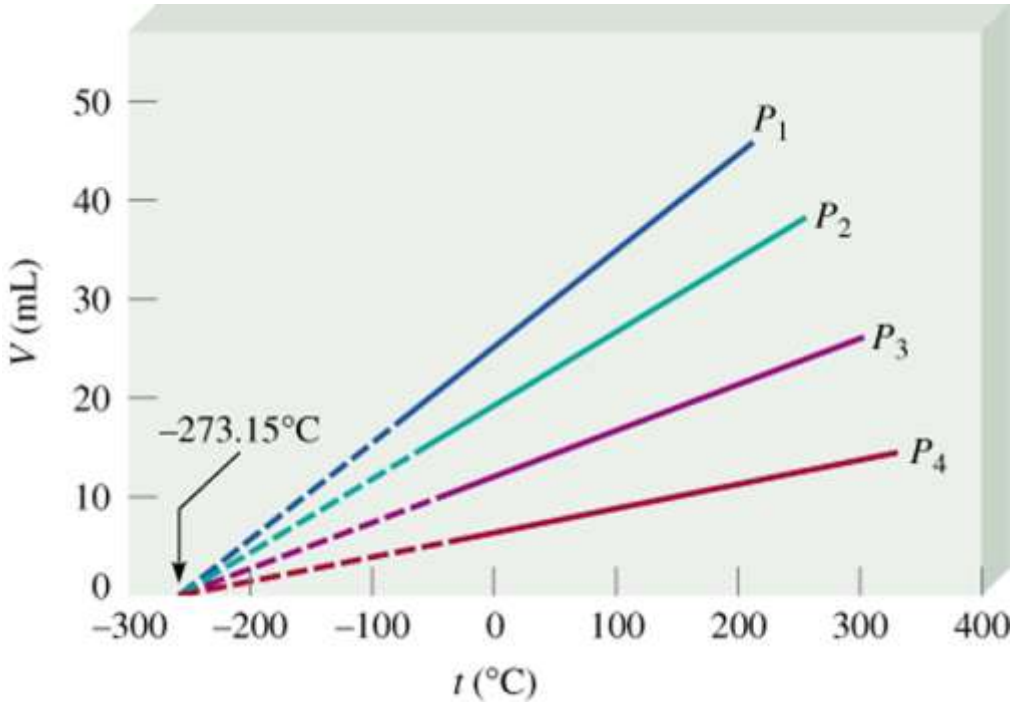
Charle's Law Lab

(at least) Four data points:

1. **One at room temperature (record the temperature)**
2. **One using 600 mL of the ice water in the cooler (make sure not to grab any ice)**
3. **One using 300mL ice water and 300 mL tap water**
4. **On at least <u>ten degrees higher</u> than room temperature (*beginning warming water as soon as you get to your lab*)**

****Do more if you have time**

Charles law?



Charles' Law

$$V \propto T$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{\% Error} = \left| \frac{\text{Theoretical Value} - \text{Experimental Value}}{\text{Theoretical Value}} \right| \times 100$$

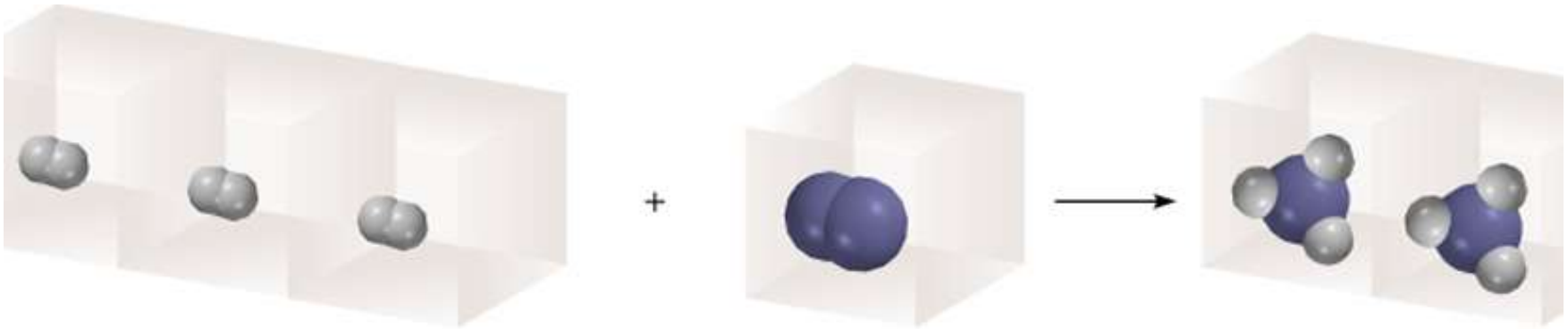
Avogadro's Law

$V \alpha$ number of moles (n)

V = constant x n

Const. Temp.
Const. Pressure

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$



$3H_2\ (g)$	+	$N_2\ (g)$	⟶	$2NH_3\ (g)$
3 molecules	+	1 molecule	⟶	2 molecules
3 moles	+	1 mole	⟶	2 moles
3 volumes	+	1 volume	⟶	2 volumes

Gas Law Practice #1

Boyle's Law Problem (#1-5):

Boyle's Law Problem with conversions (#6-11):

Charles's Law Problems, (#12-21):

Homework: Complete over weekend show all work for credit, answers are provided ☺

ACTIVITY!

- Two (2) sets of eight stations
- Two (2) people per station at a time
- One (1) prompt per station
- Three (3) minutes per prompt
- Individual answer sheets on a separate piece of paper

ACTIVITY!

For each situation explain:

1. **What gas properties are being observed (use your notes)**

2. **How do you explain these properties using the KMT (use your notes)**

3. **Give another example in which you observe the same situation**

Exit Slip

1. **List the six postulates of the Kinetic Molecular Theory.**

2. **State which one you see at play most in your every day life and give an example of how you see it.**

Bellwork 14 Mar 16

On a spring break trip to the lake you attempt to blow up a beach ball when the temp. was at 15°C. Half way through you gave up leaving the beach ball at a volume of only 3.0L. Later in the day you return to when the temp. was at 30°C, what happened to the volume of your beach ball assuming pressure and mole remain constant?

a. Describe what happened using the KMT and properties of gases *and* do the calculation.

b. What would be the diameter of the beach ball at the 30°C temperature?

c. If the ball weighted 78g and the air in side at 30°C weighted 3.77 what is the density if the air (gas) in g/L?

Bellwork 03/13/17

5.00L of H_2 gas is at a pressure of 877.0 mmHg:

1. What is the pressure of the gas in Pascals?
2. If the volume were increased to18.0L what would the new pressure be in atm?
3. How would the original pressure be different if the gas used was SF_6 instead of hydrogen? **Why?**
4. **Report the air pressure in the room in atm if the meter read 30.07inHg (in = inches, 2.54cm = 1.0in**

https://www.youtube.com/watch?v=1PJTq2xQiQ0

EQ: After you learn something that was "difficult" why is it now easy?

Agenda

Dalton's Law of Partial Pressures

Combined Gas Law/Problem solving box

Objectives

- You will apply Dalton's Law of Partial Pressures and be able to carry out calculations
- You will be able to determine which equation to use given a word problem.

Recall

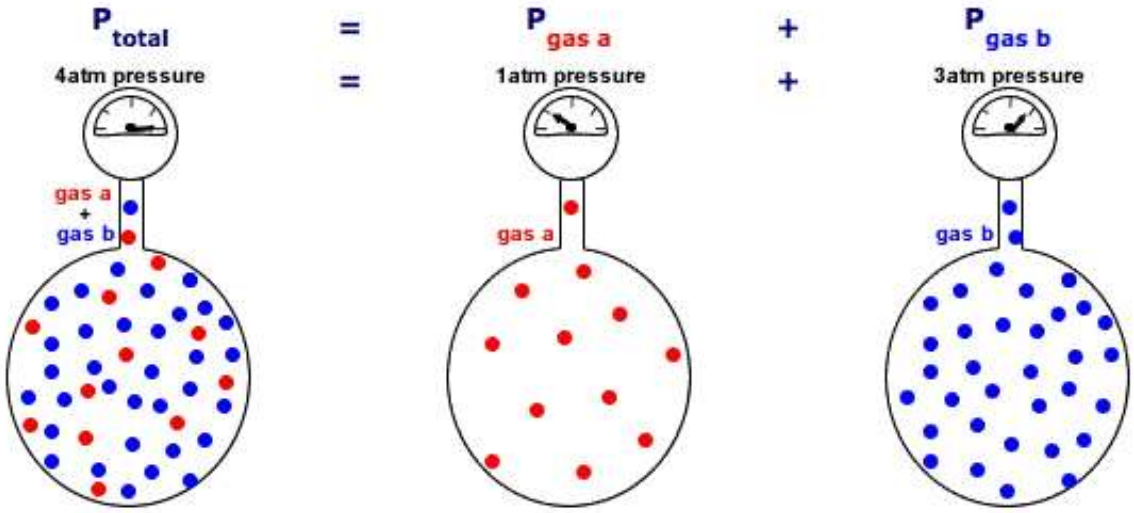
1. **Octane (gas) reacts with oxygen to form CO_2(g) and water vapor (see below). If 3,000.0 g of octane is burned how much CO_2 is formed during the reaction?**

$$2\,C_8H_{18(l)} + 25\,O_{2(g)} \longrightarrow 16\,CO_{2(g)} + 18\,H_2O_{(g)}$$

1. **Solve Boyle's law for P_2.**
2. **A sample of chlorine gas occupies a volume of 946.0mL at a pressure of 726.0mmHg. What is the pressure of the gas (in mmHg) if the volume is decreased to 154.0 mL?**

Dalton's Law of Partial Pressures

At a constant volume and temperature the total pressure exerted by a <u>mixture</u> of gases is equal to the <u>sum</u> of their individual pressures



$$P_{total} = P_1 + P_2 + P_3 \ldots P_n$$

Try This

The air around us contains oxygen, nitrogen, carbon dioxide, and trace amounts of other gases. What is the partial pressure of oxygen at 101.3 kPa of pressure if P_{N2} = 79.1 kPa, P_{CO2} = 0.04 kPa, and P_{others} = 0.94 kPa?

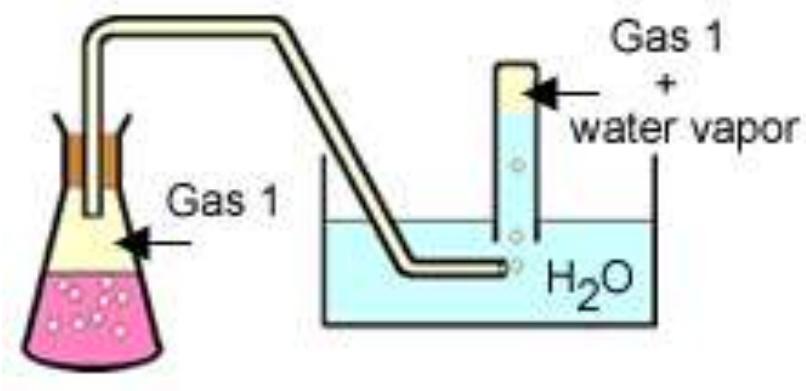
Dalton's Law of Partial Pressures

When collecting a gas over water you need to account for the "Vapor pressure" of water at the collection temperature.

To find the pressure of the dry gas alone, we need to subtract out the pressure of the water vapor.

$$P_{total} = P_{dry\ gas} + P_{water\ vapor}$$

$$P_{dry\ gas} = P_{total} - P_{water\ vapor}$$



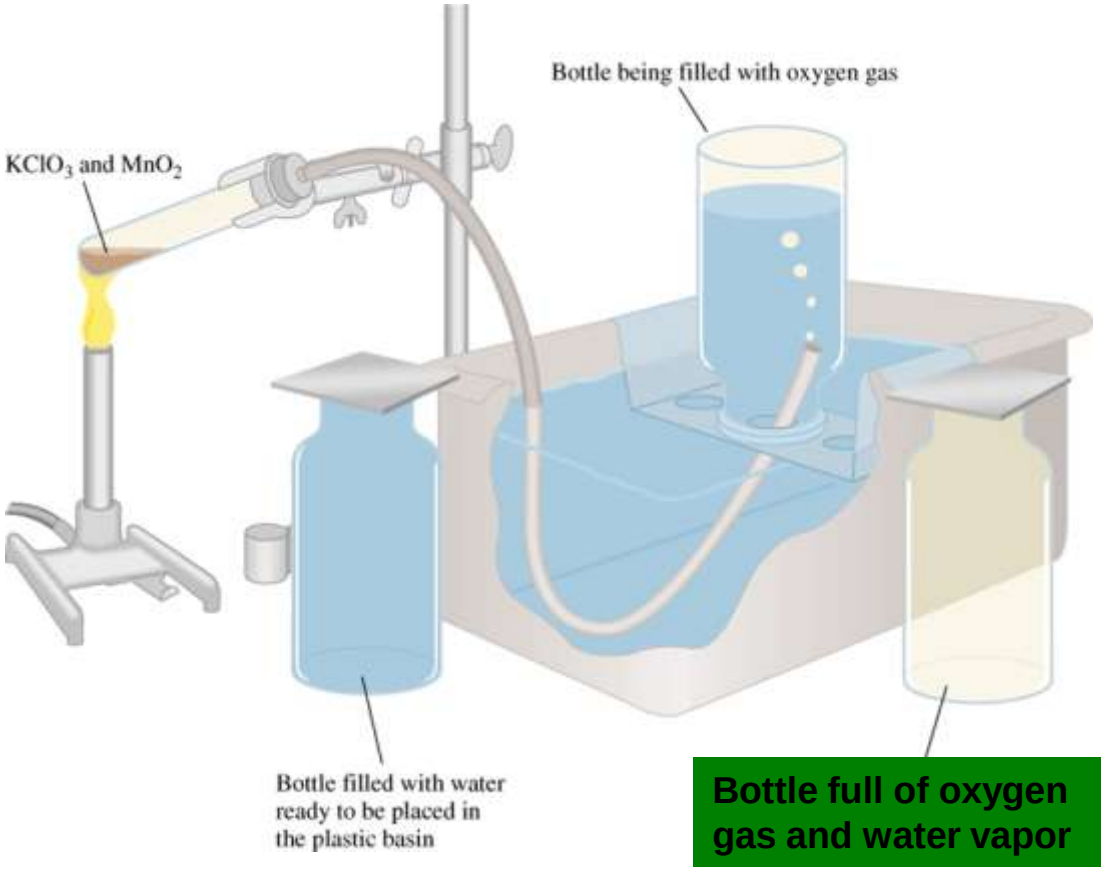


Table 5.3 Pressure of Water Vapor at Various Temperatures

Temperature (°C)	Water Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18
40	55.32
45	71.88
50	92.51
55	118.04
60	149.38
65	187.54
70	233.7
75	289.1
80	355.1
85	433.6
90	525.76
95	633.90
100	760.00

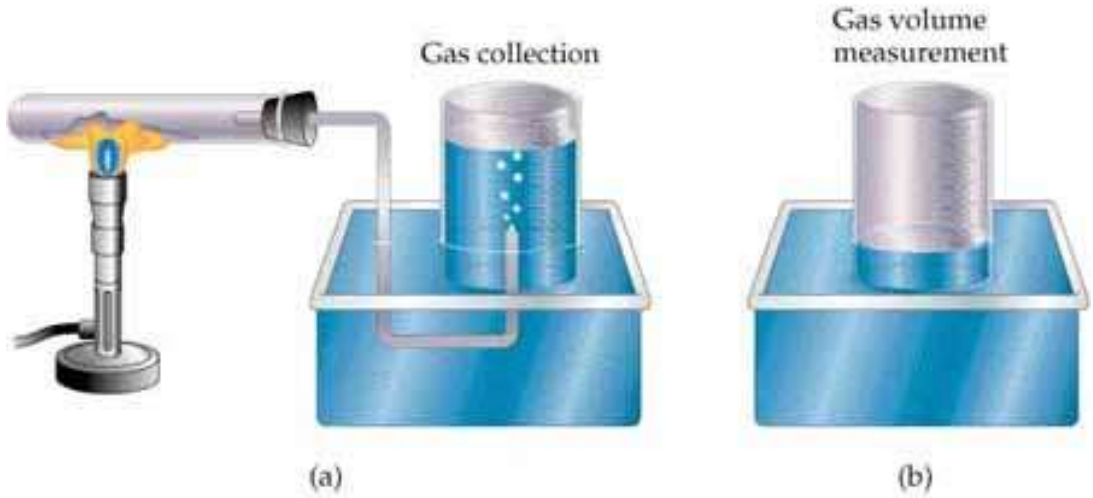
$$2KClO_3\,(s) \rightarrow 2KCl\,(s) + 3O_2\,(g)$$

$$\boldsymbol{P_T = P_{1O_2} + P_{2H_2O}}$$

Dalton's Law of Partial Pressures

A common method of gas collection in the laboratory involves displacing water from a bottle, so that you know when the bottle is full of an invisible gas.

The gas that is left in the bottle will not be pure, it will be a mixture that contains a certain amount of water vapor.



Water Vapor Pressure (torr)							
T(°C)	*P*	*T*(°C)	*P*	*T*(°C)	*P*	*T*(°C)	*P*
0	4.58	21	18.65	35	42.2	92	567.0
5	6.54	22	19.83	40	55.3	94	610.9
10	9.21	23	21.07	45	71.9	96	657.6
12	10.52	24	22.38	50	92.5	98	707.3
14	11.99	25	23.76	55	118.0	100	760.0
16	13.63	26	25.21	60	149.4	102	815.9
17	14.53	27	26.74	65	187.5	104	875.1
18	15.48	28	28.35	70	233.7	106	937.9
19	16.48	29	30.04	80	355.1	108	1004.4
20	17.54	30	31.82	90	525.8	110	1074.6

Bell Work, 14.Mar.17

$2\ Al + 2\ NaOH + 2\ H_2O \rightarrow 2\ NaAlO_2 + 3\ H_2$

We will react 2.0g Al (M.M. 27g/mol) with 10.mL of 6.0mol/L NaOH (MM 40g/mol)...

A. What volume of gas do you expect to be produced at STP (22.4L/mol)?

Table 5.3 Pressure of Water Vapor at Various Temperatures

Temperature (°C)	Water Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18
40	55.32

B. What is the partial pressure of the gas if the temp. of the water is 25˚C and the atmospheric pressure in the room is 30.04inHg?

Hint: Daltons Law of Partial Pressure

EQ: After you learn something that was "difficult" why is it now easy?

Agenda

Dalton's Law of Partial Pressures cont.

Combined Gas Law/Problem solving box

Objectives

- You will apply Dalton's Law of Partial Pressures and Combined Gas Law to be able to carry out calculations
- You will be able to determine which equation to use given a word problem.

From Bell Work, 14.Mar.

$2\ Al + 2\ NaOH + 2\ H_2O \rightarrow 2\ NaAlO_2 + 3\ H_2$

We will react 2.0g Al (M.M. 27g/mol) with 10.mL of 6.0mol/L NaOH (MM 40g/mol)...

A. What volume of gas do you expect to be produced at STP (22.4L/mol)?

Table 5.3 Pressure of Water Vapor at Various Temperatures

Temperature (°C)	Water Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18
40	55.32

B. What is the % error for the volume of H_2 collected?

$$\%\ \text{Error} = \left| \frac{\text{Theoretical Value} - \text{Experimental Value}}{\text{Theoretical Value}} \right| \times 100$$

Dalton's Law of Partial Pressures

A sample of H_2 gas is collected over water at 14.0^{o}C, vapor pressure of H_20 at 14^{o}C is1.6kPa. The pressure of the resultant mixture is 113.0kPa. What is the pressure that is exerted by the dry H_2 alone?

$P_{dry\ gas}$ = ?
P_{total} = 113.0 kPa
$P_{water\ vapor}$ = 1.6 kPa

$P_{dry\ gas} = P_{total} - P_{water\ vapor}$

$P_{H2} = 113.0\ kPa - 1.6\ kPa$

What do we know so far?

With a constant amount of particles in a sample of gas…

Boyles law

$$P_1 V_1 = P_2 V_2$$

Charles law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Gay-Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Avogadro's Law

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

How can we put it all together to determine relationships between all three?

Combined Gas Law!

When the number of gas particles in the system remains constant:

$$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$$

Rearrange the equation for:

1. **T_1**
2. **P_2**

Home Work:
“Finish Gas Laws #1”, #22-27
Due 15-Mar-2017

Word Problem Solving Box

1. What you want?	
2. Given Information	4. Plan
	5. Calculations for solutions
3. Useful formulas/ conversions	

Word Problem Solving Box

Deep sea divers have to use a mixture of gases at depth in order to avoid sickness. If a tank contains 1.60atm of O_2, 0.5atm of He and 2.9atm of N_2, what is the total pressure of the tank?

1. What you want? P_{total}

2. Given Information

P_{O2} = 1.6atm

P_{He} = 0.5atm

P_{N2} = 2.9atm

3. Useful formulas/ conversions

$P_{total} = P_1 + P_2 + P_3$

4. Plan: **Use Daltons law to solve for P_{total}**

5. Calculations for solutions

BELL WORK
15-Mar-2017

1. **Re-arrange the Combined Gas law for T_2**

2. **Why must all temperatures be converted to ____ before solving gas law problems?**

3. **A sample of hydrogen gas is collected over water at 14.0˚C (P_{H2O} = 1.6 kPa). The pressure of the resultant mixture is 117.0 kPa. What is the pressure that is exerted by the dry hydrogen alone?**

EQ: After you learn something that was "difficult" why is it now easy?

Agenda

Combined Gas Law/Problem solving box

Objectives

- You will apply Dalton's Law of Partial Pressures and Combined Gas Law to be able to carry out calculations
- You will be able to determine which equation to use given a word problem.

Gas Laws #1 Correction

23. A sample of nitrogen goes from 21 m^3 to 14 m^3 and its pressure increases from 100 kPa to 150 kPa. The final temperature is 300 K. What was the initial temperature in Kelvins?

300 K

24. A sample of argon goes from 500 K to 350 K and its pressure changes from 280 kPa to 380 kPa. If the initial volume is 18 dm^3, what is the final volume?

9.3 dm^3

25. A sample of neon experiences a pressure drop from 75 kPa to 53 kPa. The temperature increases from 27°C to 93°C. If the initial volume is 12 L, what is the final volume?

15.1 L

26. The volume of a sample of helium increases from 5 L to 25 L and its temperature drops from 2000 K to 1750 K. If the initial pressure is 1500 mm Hg, what is the final pressure?

262.5mmHg

27. The temperature of a gas increases from 212°C to 380°C. The volume goes from 30 dm^3 to 18 dm^3. If the final pressure is 1.85 atm, what was the initial pressure?

0.82 atm

Can Crushing

Using kinetic molecular theory and any of the gas laws we have discussed in class provide a written explanation for why the can had its' structure changed when plunged in cool water?

Can Data

V_1 ____

T_1 ____

P_1 ____

n_1 ____

V_2 ____

T_2 ____

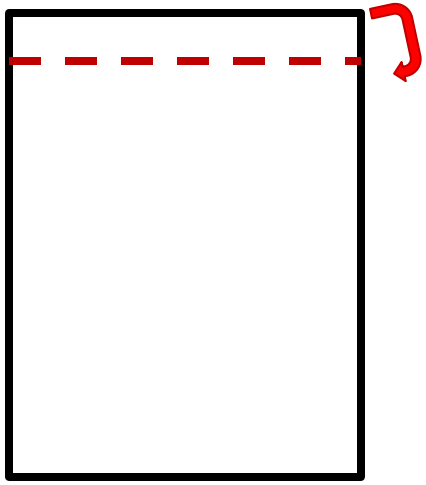
P_2 ____

n_2 ____

BELL WORK
16-Mar-2016

Please get out your " Can Crushn' " KMT and Gas law explanations paragraph. Fold the top portion of the paper back with your name.

Pass it forward,



Rearrange the ideal gas law formula fro molar mass, $\mathcal{M}$

$$d = \frac{P\mathcal{M}}{RT}$$

EQ: After you learn something that was "difficult" why is it now easy?

Agenda

Molar Mass Of Butane

Objective

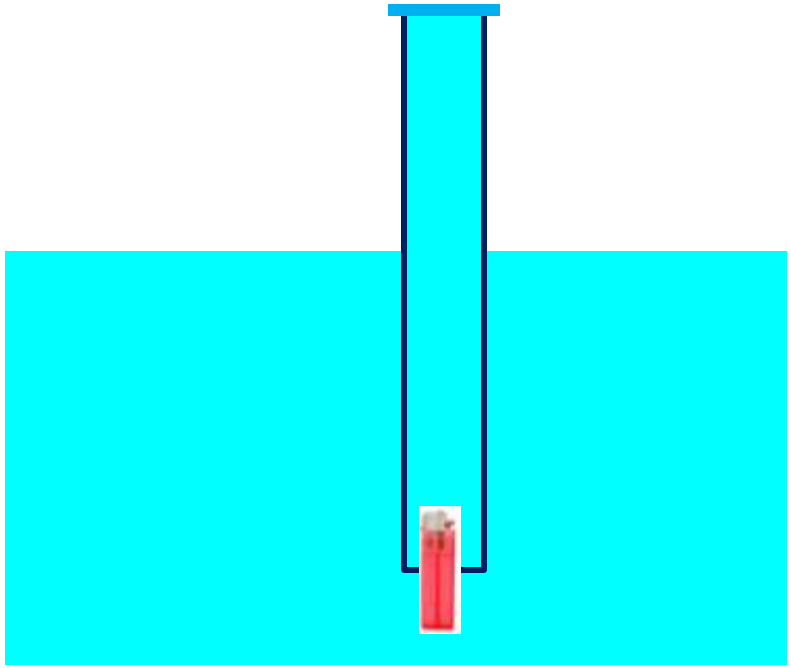
You will capture a gas over water to determine its molar mass.

Set Up

16-Mar-2017
Air pressure = 1028.5mbar
(1 mbar = 9.87×10^{-4} atm)

Pick a lighter and record mass to X.XX g

Insure lighter is ***completely dry*** and do not depress gas plunger when drying



$$\mathcal{M} = \frac{dRT}{P}$$

d =
R =
T=

P_{C4H10}=

BELL WORK
17-Mar-2017

What is the density of nitrogen gas at a pressure of 2.3atm and a temperature of 282K? Where "$\mathcal{M}$" in molar mass

$$d = \frac{P\mathcal{M}}{RT}$$

Agenda

- BIC Lighter Lab (calculating molar mass experimentally)

Objectives

- You will be able to determine the molar mass of butane experimentally
- You will be able to calculate % error in your experiment

Before you start collecting data

- **Answer the pre-lab questions and have them checked off by me**
- **Show me that you read the procedure by demonstrating it to me without the lighter**

…after this is complete you will receive your BIC lighter

Set Up

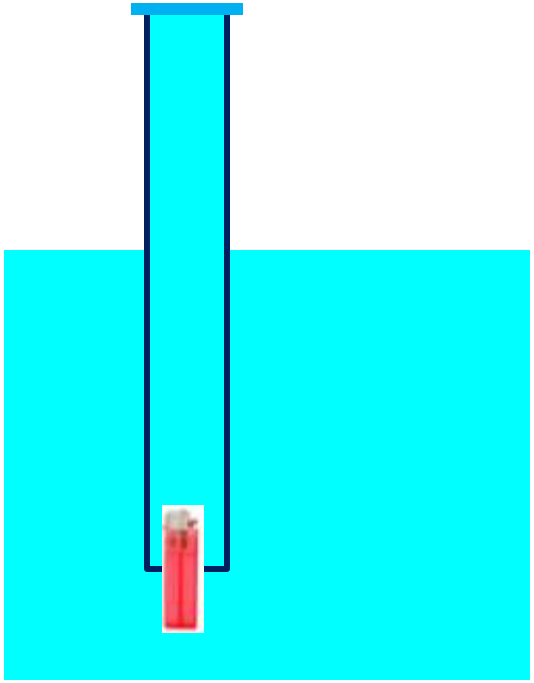
16-Mar-2017

Air pressure = 1028.5mbar

(1 mbar = 9.87×10^{-4} atm)

Pick a lighter and record mass to X.XX g

Insure lighter is ***completely dry*** and do not depress gas plunger when drying



$$\mathcal{M} = \frac{dRT}{P}$$

d =

R =

T=

P_{C4H10}=

Homework 17Mar17

Complete Gas Laws Practice ~~#1~~ #2

Bell Work, 20-Mar-2017

I. Why am I [you not Mr.G] in school? Be honest, no negative judgment in here.

II. How important is the size (volume) of an individual gas particle under KMT? Support with citation or evidence?

III. **Now, what is the volume of a 49.8g of HCl at STP?**

IV. **How many liters of gaseous CH_4 are present in a 500dm^3 tank?**

Agenda

- Idea Gas Law hello!

EQ: When in school I do what to take advantage of all the structure, support, and community?

Objectives

- You will be able to identify variables in the ideal gas law to solve for molar mass of a gas

Try this…

Ammonia burns in oxygen to form nitric oxide (NO) and water vapor. How many volumes of NO are obtained from one volume (mole) of ammonia at the same temperature and pressure?

Ammonia burns in oxygen to form nitric oxide (NO) and water vapor. How many volumes of NO are obtained from one volume of ammonia at the same temperature and pressure?

$4NH_3 + 5O_2 \quad 4NO + 6H_2O$

1 mole NH_3 1 mole NO

At constant *T* and *P*

1 volume NH_3 1 volume NO

Ideal Gas Equation

Boyle's law: $V \propto \frac{1}{P}$ (at const. *n* and *T*)

Charles' law: $V \propto T$ (at const. *n* and *P*)

Avo's law: $V \propto n$ (at const. *P* and *T*)

$$V = \text{constant} \times \frac{nT}{P} = \boldsymbol{R}\ \frac{\boldsymbol{nT}}{P}$$

$$\boldsymbol{PV = nRT}$$

$$\boldsymbol{R = 0.082057\ L \cdot atm \cdot mol^{-1} \cdot K^{-1}}$$

Standard Molar Volume: 1 mol = 22.4 L

At STP an ideal gas occupies a volume of 22.4 L/ mol

So, what volume would 1.25 mole of H_2 gas occupy at STP.

What is the volume (in liters) occupied by 49.8 g of HCl at STP, use PV=nRT?

1. What you want?

V HCl in L

2. Given Information

m= 49.8gT = 0 ˚C = 273 K

P = 1 atm

3. Useful formulas/ conversions

$PV = nRT$

$V = \frac{nRT}{P}$

4. Plan

Find mols HCl, Solve for V

5. Calculations for solutions

$n = 49.8\text{g} \times \frac{1\ \text{mol HCl}}{36.45\ \text{g HCl}} = 1.37\ \text{mol}$

$V = \frac{1.37\text{mol} \times 0.082\frac{\text{L•atm}}{\text{mol•K}} \times 273\ \text{K}}{1\ \text{atm}}$

V = 30.6 L

HOMEWORK, 20Mar17

In text book Page 481

#1-5, convert all volumes to liters and pressures to atm ☺

More practice

A 0.02 moles of oxygen gas is at 0.5 L at 0.25 atm. At what temperature (ºC) is the gas?

-197 ºC

A 334mL gas cylinder contains 8.47 g (grams → mol) of helium at 23ºC. What is the pressure (atm) assuming ideal gas behavior?

154 atm

Bellwork 03/21/17

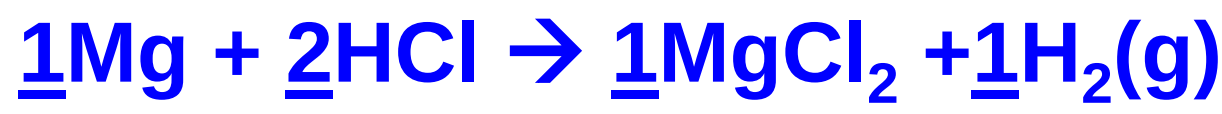
When 16.0g of Methane (CH_4,MM 16g/mol) is combusted carbon dioxide (MM 44g/mol) and water (MM 18g/mol) are produced. If the carbon dioxide occupies 5.5 L at 0.74 atm…

a. Find moles of carbon dioxide

b. Now find temperature of carbon dioxide

Bellwork 03/30/16

1. **How many moles of hydrogen gas are produced in the reaction between 0.03g of Magnesium and an excess of hydrochloric acid? (use stoichiometry)**



2. **Write out the equation for the ideal gas law and label all variables.**

3. **What is the volume of the H_2 gas produced in part 1 at a temperature of 350 K and a pressure of 0.95 atm? (use PV=nRT)**

EQ: When in school I do what to take advantage of all the structure, support, and community?

Objective

We will use Gas law Stiochiometry to determine a experimental value of “R.”

Back to Gas Collection

What was the pressure of the <u>dry gas</u> (P_{H2}) above the liquid once the reaction was complete?

V = 35mL
n = $1.25E^{-3}$ mol
R = 0.0821
T = 298 K
P_{total} = ?

$$P = \frac{nRT}{V} = \frac{1.25E^{-3}\,mol \times 0.0821 \times 298K}{3.5E^{-2}\,L}$$

$$P_{total} = 0.0306$$

$$P_{dry\ gas} = P_{total} - P_{H20}$$

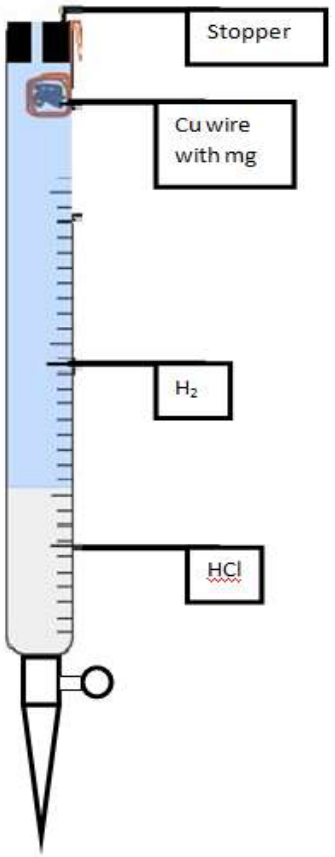
$$= 1\ atm - 0.0312atm$$

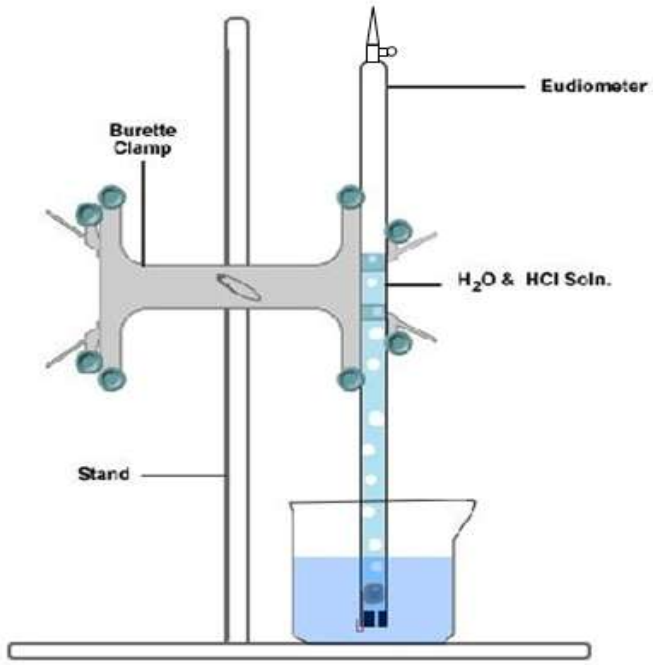
$$= 0.969\ atm$$

Temperature (°C)	Vapor Pressure (mmHg)
0	4.58
5	6.54
10	9.21
15	12.79
20	17.54
25	23.76
30	31.82
35	42.18

Experimental Determination of the Ideal Gas Constant

Air Pressure
22Mar17
30.21inHg





Bellwork
23.Mar.17

1. **5.0g of magnesium reacts with 5.0g of hydrochloric acid. How many moles of hydrogen gas are produced?**

$$1Mg + 2HCl \rightarrow MgCl_2 + H_2(g)$$

2. **Using the value calculated from above, determine the volume of hydrogen produced at 760 mmHg and 298K.**

EQ: When in school I do what to take advantage of all the structure, support, and community?

Agenda

- Calculating ideal gas constant and stiochiometry and using Ideal Gas Law

Objectives

You will know when to use the ideal gas law and be able to rearrange it to solve for any variable

You will be able to use the ideal gas law to calculate the volumes and quantities of gas reactions

Ideal Gas Law Review

Boyle's law: $V \propto \frac{1}{P}$ (at const. *n* and *T*)

Charles' law: $V \propto T$ (at const. *n* and *P*)

Avo's law: $V \propto n$ (at const. *P* and *T*)

$$V = \text{constant} \times \frac{nT}{P} = \boldsymbol{R}\frac{\boldsymbol{nT}}{P}$$

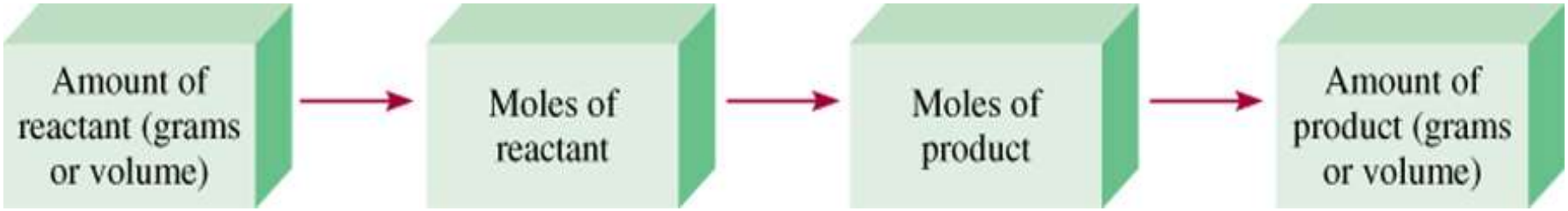
$$\boldsymbol{PV = nRT}$$

$$\boldsymbol{R = 0.082057\ L \bullet atm / (mol \bullet K)}$$

Try This

What is the <u>volume</u> of CO_2 produced at 370 ºC and 1.00 atm when 2.50 g of Ethanol (C_2H_5OH) are used up in the rxn.

$1C_2H_5OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$



$1C_2H_5OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

1. What you want? V_{CO2}

2. Given Information

T = 370ºC
P = 1atm
Mass of reactant = 2.5g

3. Useful formulas/ conversions
PV = nRT

4. Plan

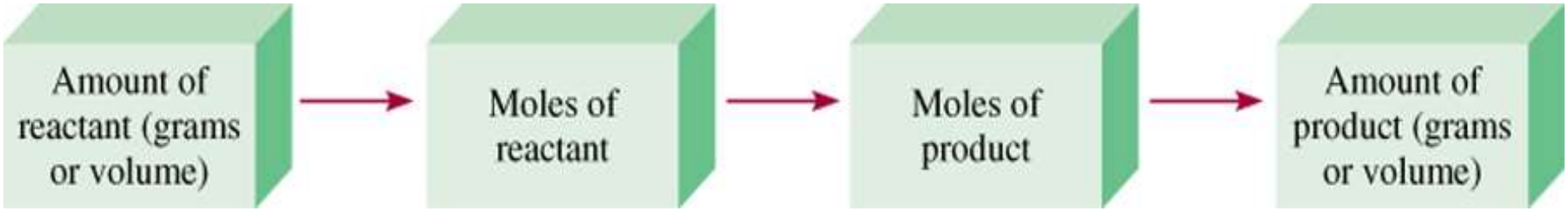
5. Calculations for solutions

1.) Calculate how much product can be produced in moles (n)…(gA→molB)

gA x (1 mol/m.m.A) x (molB/molA)

2.) Using ideal gas law and the value from step one calculate the volume (L) of the gas at the given conditions.

V = nRT/P



More Practice

$\underline{1}CH_4\,(g) + \underline{2}O_2\,(g) \rightarrow \underline{2}H_2O(l) + \underline{1}CO_2\,(g)$

How many moles of O_2 are used to produce the 3.0L of CO_2 at 400K and 5atm?

Try This

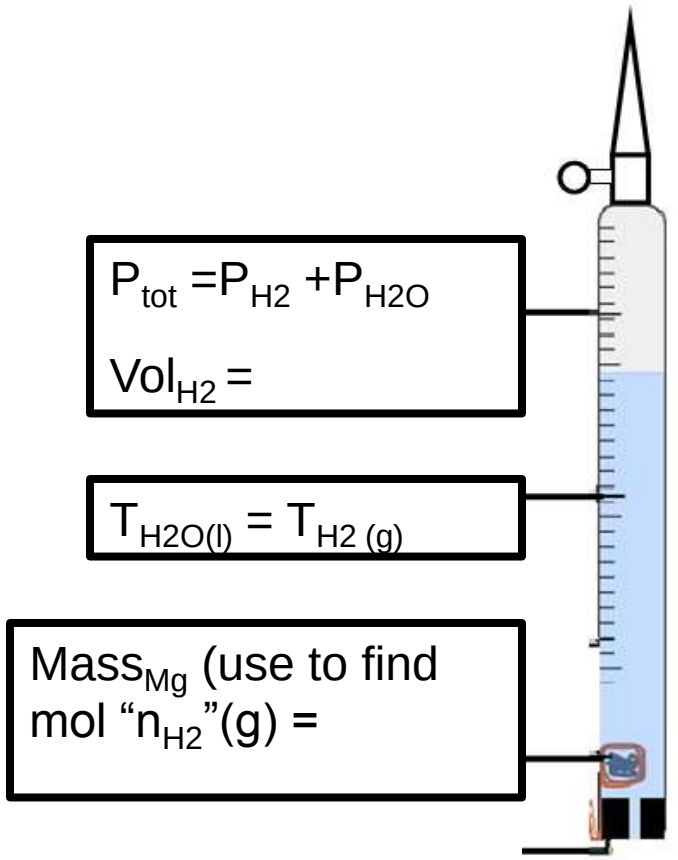
$$C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(g)}$$

What <u>volume</u> of water is produced at <u>STP</u> if 7.0 grams of glucose ($C_6H_{12}O_6$) are combusted?

Experimental Determination of the Ideal Gas Constant

Air Pressure (P_{tot}) on 22Mar17 30.21inHg

Use the data collected in the lab to solve the ideal gas law for "R"



Home Work, 23Mar2017

- Bring a 300mL – 750mL empty water bottle for rockets on the 24th!
- Determination of Ideal Gas Constant lab
- Ideal Gas law Practice Problems